On the Discharge of Negative Electricity from Hot Calcium and from Lime.

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(Abstract.)

This paper contains an account of some experiments in which the negative leak from hot calcium was compared with that from platinum and from lime under similar conditions. The experiments were conducted in an atmosphere of argon or helium at a few millimetres pressure. The method of experimenting was as follows:—The negative leak from a platinum strip, heated by an electric current, was first investigated. The temperature of the strip was indicated by a thermo-couple of wires of platinum and platinum with 10 per cent. of rhodium, and the leak was measured by a delicate d'Arsonval galvanometer. Without changing the apparatus, the cathode was covered with metallic calcium by sublimation from an electrically heated calcium wire situated in the discharge tube near to the cathode. The negative leak from the calcium-covered cathode was determined at different temperatures. Some pure oxygen was then let into the apparatus and the calcium on the cathode was oxidised to lime. The excess of oxygen was then removed and the negative leak again measured. Finally, hydrogen was let into the apparatus and the effect of this gas on the negative leak from lime was investigated.

The results contained in the paper may be summarised as follows:—

(1) The experiments with a platinum cathode showed that the negative leak from platinum in helium or argon at low pressures is practically the same as in air or oxygen. The variation of the negative leak per square centimetre with the temperature of the cathode can be expressed by an equation of the form used by O. W. Richardson and by H. A. Wilson, viz., $x = A\theta^{\frac{1}{2}}\epsilon^{-Q/2\theta}$, where x is the current in ampères, θ the absolute temperature, and Q and A are constants.

(2) The negative leak from calcium is much greater than from platinum at the same temperature. As with platinum, the variation of the leak with temperature can be expressed by the above equation, but the values of the negative leaks from calcium at different temperatures do not so closely agree with the values calculated from the equation as in the case of platinum. This is probably due to the greater experimental difficulties attending the use of calcium.

(3) On oxidising the calcium on the cathode to lime there is an enormous increase in the negative leak, the leak from a lime cathode at 950° C. being about the same as the leak from calcium at 1400° C. The variation of the negative leak from lime with the temperature is not constant, but slowly decreases with continued heating.

(4) The negative leak from lime in hydrogen is much greater than that in air or helium.

Since calcium is a much more electro-positive metal than platinum, it was to be expected that the negative leak from calcium would be greater than that from platinum at the same temperature. It would also be expected that the negative leak from calcium would be greater than that from lime under similar conditions; for in the case of lime we should expect the presence in the molecule of the electro-negative atom of oxygen to act as an attracting force tending to retain the escaping corpuscle. The present experiments, however, show that the negative leak from lime is greater than that from calcium. It is interesting to note that the metallic oxides which give the largest emissions of negative corpuscles when heated are the alkaline earths, and it is these also which exhibit most strongly the property of glowing when heated to a high temperature. It is not improbable that there is some connection between these two phenomena.